ROOF MODULE AND METHOD OF PRODUCING A ROOF MODULE

REFERENCE TO RELATED APPLICATIONS

[1] The present invention is a divisional of United States Patent Application No. 10,225,970, filed August 22, 2002, and which claims the benefit of German Patent Application No. 101 41 242.8, filed August 23, 2001.

TECHNICAL FIELD

[2] The invention relates to a roof module comprising an outer shell and a foamed inner shell. The invention further relates to a method of producing such a roof module.

[3] Hitherto, the roof module has been produced by placing the outer shell, the rim of which is configured with an excess width, into a foaming mold and subsequently applying the inner shell onto the inner side of the outer shell by foaming. In the process, the inner shell extends as far as to the rim of the outer shell. After foaming, the rim of the outer shell together with the inner shell applied by foaming is cut to size. Cutting to size of the outer shell provided with the inner shell is a difficult operation during which a lot of dirt occurs. Moreover, that part of the inner shell which is on the cut-off rims of the outer shell, represents cuttings, this increasing the production costs. Finally, the roof module has exposed edges of cut after it has been cut to size.

[4] It is the object of the invention to improve a roof module of the type initially mentioned as well as a method of its production to the effect that fewer cuttings and, hence, lower production costs are produced and that the roof module does not have edges of cut which are exposed.

SUMMARY OF THE INVENTION

[5] According to the invention, a roof module is provided which comprises an outer shell and a foamed inner shell. The outer shell has a rim including an edge of cut and the inner shell extends as far as on the edge of cut. Such a roof module may be obtained by the following method: firstly, an outer shell is made available. Then the rims of the outer shell are cut to size. As a next step, the outer shell is placed in a foaming tool and a curable material is applied onto the outer shell. Subsequently the foaming tool is closed, a seal n the foaming tool pressing against the rim of the outer shell from outside towards inside. The

curable material hardens, it reaching the edges of cut on the rim of the outer shell. The roof module produced in this way does not have to be cut to size after the foaming operation. Consequently, only so much of the material for the inner shell has to be introduced as is actually required for it; no loss occurs. As the inner shell extends as far as on the edges of cut at the rim of the outer shell, the edges of cut – which have been produced prior to foaming on cutting the outer shell to size – are sealed.

[6] According to a preferred embodiment, it is provided for that the outer shell is configured with an undercut on its rim. This can be obtained in that, on producing the roof module, the seal is pressed elastically against the outer shell when the foaming tool is being closed and plastically deforms the outer shell in this process. It is not required in this procedure to provide slider elements in the foaming tool which usually are required for producing the undercut on foaming. It is not required either that the outer shell has the undercut already before foaming. This, in fact, could be managed during production of the outer shell only with large expenditure.

[7] Advantageous designs of the invention will be apparent from the subclaims.

BRIEF DESCRIPTION OF THE DRAWINGS

[8] Figure 1 shows in a broken sectional view a foaming tool in the open state, with an inserted outer shell according to a first embodiment.

[9] Figure 2 shows the foaming tool of Fig. 1 in the closed state, an inner shell being applied to the outer shell by foaming;

[10] Figure 3 shows a detailed of Fig. 2 on an enlarged scale;

[11] Figure 4 shows in a broken sectional view a foaming tool in the closed state, with an outer shell and an inner shell applied by foaming, according to a second embodiment; and

[12] Figure 5 shows a detail of Fig. 4 on an enlarged scale.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[13] In Figs. 1 to 3 these is schematically shown a foaming tool 10 which consists of an upper part 12 and a lower part 14. Received in the lower part 14 is an outer shell 16 which will be a part of the roof module and which may consist of aluminum or plastics, for

instance. The outer shell 16 has a rim 18 that ends at an edge of cut 20. The edge of cut is produced in the course of cutting the outer shell 16 to size.

[14] In the lower part 14 of the foaming tool 10, there is received a seal 22 which has a base section 24 anchored in the lower part 14 and a head section 26 associated to the rim 18 of the outer shell 16. The seal 22 is made of a material which on the one hand has sufficient resistance to pressure and temperature with regard to the foaming operation and which is elastically deformable, on the other.

[15] The upper part 12 of the foaming tool 10 has a sealing section associated to the rim 18 of the outer shell 16 and the head section 26 of the sealing 22. The sealing section consists of an end surface 30 and a pressure surface 32. The end surface 30 extends approximately perpendicular to the direction along which the upper part 12 and the lower part 14 of the foaming tool 10 are movable relative to each other. The pressure surface 32 extends obliquely to the end surface.

[16] When the foaming tool 10 is transferred from the open position shown in Fig. 1 into the closed position shown in Fig. 2, the obliquely extending pressure surface 32 engages the head section 26 of the elastic seal 22 and moves this head section to the left due to a wedge effect. In so doing, the rim 18 resting at the head section 26 of the seal 22 is likewise moved to the left. When the foaming tool is in the closed state, the end surface 32 rests tightly on the upper side of the head section 26 of the seal 22. The edge of cut 20 of the rim 18 of the outer shell 16 lies opposite the end surface 30 at a small distance (see in particular Fig. 3).

[17] Prior to closing the foaming tool 10, there has been applied onto the outer shell 16 a foamable material which cures when the foaming tool has been closed, so that it forms an inner shell 34 on the inner side of the outer shell 16. As can be taken in particular from Fig. 3, the inner shell extends along the rim 18 as far as on the edge of cut 20 which is covered by the material of the inner shell 34. In the region where the material of the inner shell 34 rests at the head section 26 of the seal 22, namely between the edge of cut 20 on the outer shell 15 and the end surface 30 of the upper part 12 of the foaming tool, the inner shell extends away from the edge of cut in extension of the outer surface of the outer shell. The material which is present there, seals the edge of cut 20. As the head section 26 of the seal has moved the rim 18 of the outer shell 16 towards inside on closing the foaming tool, the rim 18 of the outer shell 16 rests at the head section 26 of the seal 22 with a sufficiently high force, so that

the material of the inner shell 34 cannot enter the region between the rim 18 of the outer shell 16 and the head section 26 of the seal 22 and, hence, cannot emerge from the foaming tool. With this, the rims of the roof module formed by the outer shell 16 and the inner shell 34 are smooth after foaming, without the need of a subsequent cutting operation.

[18] In Figs. 4 and 5 there is shown a roof module according to a second embodiment. The same reference numerals will be used for the components known from the first embodiment, and reference is made to the above explanations.

[19] The difference between the first and the second embodiment is that in the second embodiment the pressure surface 32 is inclined more, so that upon closing the foaming tool the head section 26 of the seal 22 is moved to the left to a greater extent. In the process, the rim 18 of the outer shell 16 is moved to the middle of the outer shell 16 so far that the outer shell is undercut, i.e., the edge of cut lying further inwardly than does the rim 18 in the region of the transition to the horizontally extending middle section of the outer shell 16. The deformation of the rim 18 on closing the foaming tool is preferably a plastic one, so that after opening the foaming tool only a slight spring-back occurs which does not impose an exceed load on the fit of the inner shell 34 on the outer shell 16. It is e.g. in the region of the rear flap of a vehicle provided with the roof module where the undercut can be of advantage.

[20] The foregoing description is only exemplary of the principles of the invention. Many modifications and variations of the present invention are possible in light of the above teachings. The preferred embodiments of this invention have been disclosed, however, so that one of ordinary skill in the art would recognize that certain modifications would come within the scope of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described. For that reason, the following claims should be studied to determine the true scope and content of this invention.